

# Community photo-triage for skin cancer referrals: an aid to service delivery

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## Summary

**Background.** We wished to investigate the potential for extending the capacity of the specialist service by using community-based photo-triage for suspected skin cancers.

**Aims.** To compare the outcomes and costs of conventional and photo-triage referral pathways.

**Methods.** This was an observational study of conventional and photo-triage referrals. Patients referred for initial photo-triage were invited to visit a medical photographer located in community health centres, who would take high-quality close-up and dermatoscopic images of the patients' lesions. A dermatologist then reviewed the images, and triaged patients to specific treatment clinics. All patients referred by conventional letter were offered initial appointments at the consultant-delivered skin cancer clinic. The difference in costs was assessed by modelling health service use under both pathways.

**Results.** Photo-triage permitted 91% of patients (263/289) to achieve definitive care at first visit to the specialist team, compared with only 63% (117/186) via the conventional referral pathway. The mean waiting time to definitive treatment for patients with skin cancer was slightly reduced with photo-triage. Photo-triage permitted direct booking for 45% of patients to attend a nurse-delivered clinic, 22% to attend directly for surgery, 2% to attend a community general practice clinic and 2% to be referred on electronically to another specialty. This reduced by 72% the number of patients requiring attendance to the consultant clinic, freeing up capacity. Despite the cost of providing medical photography, there was a small cost saving of around £1.70 per patient using photo-triage.

**Conclusions.** Community photo-triage improved referral management of patients with suspected skin cancer, improving the delivery of definitive care at first visit and achieved an increased service capacity. Cost comparison found that the photo-triage model described was marginally cheaper than conventional care, and reduced hospital visits. An integrated primary–secondary care referral pathway that includes photo-triage facilitates a more efficient specialist service while ensuring that all suspicious lesions are viewed by an experienced dermatologist.

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## Introduction

Increasing demand for specialist dermatological consultations, combined with the continued drive to speed up patient access, is placing enormous pressure on dermatology services.<sup>1</sup> Around half the referrals to many specialist departments are for the diagnosis and management of potential skin cancer lesions, posing a challenge to clinicians to provide a safe and timely service to reassure patients with benign growths, while efficiently progressing the care of those with skin cancer.

Prioritizing patients on the basis of information contained within a referral letter has limitations. Store-and-forward teledermatology (SFTD), involving the transmission of digital images and patient data for later assessment, has been widely studied and shows potential as a triage method for suspected skin cancer.<sup>2</sup> May *et al.*<sup>3</sup> reported that SFTD improved prioritization and reduced waiting times for patients with malignant melanoma (MM) and squamous cell carcinoma (SCC). Moreno-Ramirez *et al.*<sup>4</sup> reported a 17-month study in which 12 primary care centres referred > 2000 patients with suspected skin cancer for triage via SFTD; over 51% of visits to the specialist centre were avoided via triage, which also shortened waiting time from 88 days via conventional letter to 12 days via teledermatology. This method of referral management has recently been shown to be cost-effective.<sup>5</sup>

In a recent systematic literature review, Eminovic *et al.*<sup>6</sup> concluded that although teledermatology seems to be a valuable application, further study of clinical outcomes and cost-effectiveness is required before its wider implementation can be considered. In another review of teledermatology, Whited compared the costs of several real-time teledermatology systems, and found some models to be cheaper than conventional care.<sup>7</sup> He commented on the lack of similar data for SFTD, although it is typically less expensive than real-time teledermatology.

We performed a study to compare the costs and outcomes of SFTD compared with conventional letter referral for skin cancer triage where all patients subsequently attend one of the secondary care team. Only patients referred for an urgent appointment, where the general practitioner (GP) suspected skin cancer, were assessed in this study. In Scotland, we are working towards a referral to treatment target of 62 days for such referrals (the 2-week rule applying to most of the UK does not apply in Scotland), hence a triage system that increases the rate of delivery of definitive care at first visit to a specialist unit is of particular interest.

## Methods

As this was a service evaluation, approval from an ethics committee was not required. Informed consent was obtained before photography.

The study was an open observational design to compare conventional letter and photo-triage referral pathways. Data were collected on patient pathways including the services they received, waiting time, location of practices, and patient demographics including age. The latter were collected to identify possible differences between the study populations. To compare the cost per patient, health service use was modelled for both pathways for the same cohort of patients. Costs were estimated from a UK National Health Service (NHS) perspective. In the absence of a local medical illustration service, the medical photographer and costs for equipment use were purchased via a service agreement with a neighbouring NHS Health Board.

The study was performed during the period January to June 2008 inclusive, with referring GPs given the choice to refer patients either via a conventional electronic letter (Scottish Care Initiative; SCI) or through a dedicated skin cancer standard referral form in the SCI system, on which users are prompted to offer patients the opportunity to attend for screening photographs at one of two community locations close to the region's main population foci in Forth Valley (population 285 000). The patient is advised to phone a dedicated booking line at the Forth Valley Dermatology Centre to agree a date to attend for imaging by a professional medical photographer at one of the two community locations (strategically located large general practices). To prevent patient delay, patients in the study who were unable to attend for photography within 2 weeks of referral were offered a clinic appointment in accordance with the conventional referral pathway.

During the photography session, up to four high-quality images, including dermatoscopic images, were taken for each patient: a regional view, a close-up, an optional angled shot to show the elevation of the lesion, and a dermatoscopic image. A standard appointment time of 10 min was allocated. During this pilot phase of the service, 30 patients could attend during the 1 day of screening per week. High-quality electronic (JPEG) files were loaded onto a secure, password-protected server using FOTOWEB and FOSTATION software, and accessed via the hospital intranet.

The images were available for the consultant dermatologist to view, along with the SCI referral letter from the GP. Photo-triage referrals were typically viewed the

day after photography, whereas conventional SCI referrals were triaged daily on receipt by the central Dermatology Service. For this study, only referrals considered suspicious for skin cancer and therefore graded 'urgent' were assessed.

For triage referrals, the dermatologist recorded a diagnosis based on the images and written information in the SCI letter. They also allocated the referral to the clinic considered most suitable to each case (consultant-led skin cancer clinic, nurse-led clinic, nurse-led cryotherapy clinic, direct skin surgery list, direct-book photodynamic therapy list) or to onward electronic referral to another specialist. Patients referred via conventional route were all booked to attend the consultant-led skin cancer clinic. To ensure safety during this assessment phase of the service, all patients attended the hospital service, with no referrals passed back to their GP after triage. All staff involved in the initial assessment of skin cancer patients were members of the local skin cancer multidisciplinary team.

## Results

During the study period, 231 lesion referrals graded by GPs as 'urgent suspected cancer' were received by conventional electronic letter, and 411 'urgent suspected cancer' referrals were made via the photo-triage pathway, although only 321 patients attended for photography, with the remaining 90 patients failing or being unable to attend either of the two dates offered for photography. Data were complete for 188 patients referred via the conventional pathway and for 289 patients in the photo-triage pathway. Reasons for incomplete data included patient-initiated cancellation of the referral, or their failure to attend a follow-up clinic. Proportionately more women attended the photo-triage service (M : F 118 : 171) compared with patients referred via the conventional pathway (M : F 95 : 93), however, mean age was similar at 51 years (range 4–91) and 52 years (10–95), respectively. Analysis of the geographical spread of the referred patients found similar proportions of patients referred to each pathway from outlying areas; however, around the two sites of community photography, one area referred 70 referrals via triage and only 26 by standard letter, whereas the other population hub had an excess of referrals via standard letter (70 vs. 41). A subsequent GP questionnaire indicated that this difference was probably due to (lack of) awareness by GPs of the new pathway, as few patients were reluctant to travel.

In total, 91% of patients attending via photo-triage received definitive care (treatment or reassurance) at

their initial visit to the specialist team, compared with 63% via the conventional route (Table 1). In addition, photo-triage diverted 72% of referrals away from the conventional consultant-led skin cancer clinic. This was achieved predominantly through the direct booking of operations for patients with lesions identified from photo-triage as requiring surgery, and referral of patients with benign lesions to the nurse-led clinic for reassurance or to nurse-delivered cryotherapy for appropriate lesions.

To determine whether or not the use of photo-triage might alter the pattern of care, such as producing a reduced threshold for surgery, the outcomes of consultations for patients referred via the two pathways were compared. Despite the population studied containing only patients referred for urgent assessment because of concern over possible skin cancer, assessment gave a diagnosis of benign lesion for 43% of patients on the conventional pathway and 49% of those on the photo-triage pathway, thus only reassurance rather than lesion removal was required. Excision surgery was required for 33% of photo-triage pathway and 34% of conventional pathway patients; 19% and 14% of lesions, respectively, were treated with cryotherapy. Patients in the photo-triage group receiving surgery included the 63 patients booked directly at triage, the 7 patients referred on to another specialty (all to maxillofacial surgery) plus an additional 25 patients for whom a decision to progress to surgery was made after clinic attendance.

Waiting time for skin cancer patients was shorter in the photo-triage group, despite the additional step of attendance for photography and the study design, which led to conventionally referred patients filling up the first available clinic appointments ahead of triaged patients because of the wait for imaging, which risked additional delay for clinic appointments for the triage patients. Mean waiting times for MM, SCC and basal cell carcinoma (SCC) were, respectively, 39, 50 and 58 days for patients referred conventionally, and 36, 28 and 35 days for photo-triage patients.

Although diagnostic accuracy was not a primary outcome measure of this study, comparison of GP diagnoses with subsequent biopsy or consultant diagnosis indicated that 45% of BCCs (44/97), but only 9% of suspected MMs (28/294) and 9% of SCCs (3/32) were identified correctly in the letter. Photo-triage correctly identified 65 of 69 benign naevi (94%), 55 of 59 seborrhoeic keratosis (SKs) (93%), all 8 angiomas (100%) and 10 of 12 actinic keratoses (83%). All three SCCs were identified, as were 26 of 29 BCCs (90%).

Photo-triage identified 11 of 13 (85%) of MMs, with the remaining 2 lesions triaged for consultant clinic assessment (and then for surgery) as an atypical naevus and a traumatized SK, respectively. No patient subsequently shown to have MM was triaged to a clinic for reassurance.

Health service use was modelled for the cohort of 289 patients who were referred through photo-triage, had they followed the conventional pathway. Table 1 shows

the services the patients would have received under the conventional pathway. Table 2 shows the differences in percentage of services received based on the estimates in Table 1, and the average cost per patient between the two pathways. There was a small cost saving of around £1.70 per patient when using photo-triage compared with the conventional system. Overheads were not included, as these are unlikely to change as a result of the photo-triage system.

Pathway and treatment	n (%)	Conventional alternative*
Conventional		–
Consultant diagnostic clinic	188 (100)	–
Reassurance	92 (48.9)	–
Cryotherapy	27 (14.4)	–
Referred to surgery	64 (34.0)	–
Referred to nurse-led clinic for topicals	5 (2.7)	–
Referred for PDT	2 (1.1)	–
Photo-triage		
Consultant diagnostic clinic	82 (28.4)	Consultant clinic
Reassurance	56 (19.4)	Consultant clinic
Cryotherapy	11 (3.8)	Consultant clinic + surgery
Referred to surgery	14 (4.8)	Consultant clinic + nurse clinic
Referred to nurse-led clinic for topicals	1 (0.3)	
Nurse-led clinic	121 (41.9)	
Reassurance	66 (22.8)	Consultant clinic
Cryotherapy	42 (14.5)	Consultant clinic
Topical treatment	5 (1.7)	Consultant clinic + nurse clinic
Referred to surgery	8 (2.8)	Consultant clinic + surgery
Direct surgical list	63 (21.8)	Consultant clinic + surgery
Direct PDT	9 (3.1)	Consultant clinic + PDT
Community GP special interest clinic	7 (2.4)	
Reassurance	1 (0.3)	Consultant clinic
Cryotherapy	3 (1.0)	Consultant clinic
Referred to surgery	3 (1.0)	Consultant clinic + surgery
Direct to another specialty	7 (2.4)	Consultant clinic + other specialty

**Table 1** Services received in conventional and photo-triage pathways.

GP, general practitioner; PDT, photodynamic therapy. \*Services that would have been received if photo-triage patients had followed the conventional pathway.

**Table 2** Difference in average cost per patient between photo-triage and conventional pathways.

	Proportion			Unit cost, GBP*	Difference in cost, GBP
	Photo-triage	Conventional	Difference		
Photo-triage	1.00	0.00	1.00	8.00	8.00
Consultant clinic	0.28	1.00	–0.72	18.88	–13.52
Nurse clinic	0.42†	0.02‡	0.40	8.40	3.37
Surgery	0.30‡	0.30¶	0.00		
PDT	0.03	0.03	0.00		
GPwSI	0.02	0.00	0.02	18.88	0.45
Other specialty	0.02	0.02	0.00		
Total	1.00	0.00	1.00		–1.70

GPwSI, general practitioner with a special interest; PDT, photodynamic therapy. \*Details are reported in Appendix 1; †(0.419 + 0.0027 + 0.0003); ‡(0.218 + 0.048 + 0.028 + 0.010); §(0.003 + 0.017); ¶(0.048 + 0.028 + 0.218 + 0.010).

## Discussion

We found that a model of referral management that included a form of SFTD, photo-triage, can improve delivery of the service and yet remain cost-effective even when all patients still attend one of the secondary care team. Although photo-triage involved patient attendance for imaging, this was located in the community to ease access. The result was definitive care was delivered to 91% of patients at their first visit to secondary care team, which released 72% of the consultant clinic appointments, increasing the capacity of the service by using direct booking to surgery and other treatment clinics, and by enhancing nurse-led delivery of care. Patients with skin cancer were seen slightly more quickly; discontinuation of the conventional referral pathway is anticipated to further reduce waiting times for patients triaged with possible skin cancer. Patients requiring the opinion of other surgical clinics avoided duplication of hospital visits. We await full roll-out of the service, intended for all suspicious lesions, before being able to assess its ability to capture all primary SCCs and melanomas and to optimize accessibility to the service, noting that relatively fewer men than women used the service. The average cost per patient was slightly lower under photo-triage. The cost analysis did not take into account the cost of training and setting-up of the service; the services of a senior trained photographer with his own equipment were bought in. For a department setting up a new service rather than 'leasing' existing photography services, the initial set-up costs of equipment purchase and training may be substantial, although these are likely to be offset by the prolonged period of use.

SFTD is considered inferior to face-to-face consultation as a method of clinical assessment, with the benefits of lesion palpation, additional enquiry and examination likely to add value to the patient assessment.<sup>8</sup> However, the rising demand for skin lesion assessment, limited numbers of consultants and economic pressures to redesign rather than expand specialist services, led us to evaluate a community-based photo-triage model that still preserved the option of patient contact with one of the secondary care team.

In the literature, the level of diagnostic concordance between images and face-to-face consultations typically ranges from 81% to 89%, although it was only 48% in one study, in which image quality issues and limited lesion details may have influenced the results.<sup>4,7,9,10</sup> Utilization of hospital medical photographers was described in 1998 by Harrison *et al.*,<sup>11</sup> with high-quality prints generated to assist patient triage, producing a diagnostic accuracy of 71%, including 94% of malignant

skin lesions. McLaughlin *et al.*<sup>12</sup> used digital images produced by medical photographers in an initial open study of skin lesions, and found matching of photographic with subsequent clinical diagnosis in 88% of cases, with uncertainty in diagnosis in only one case, for which diagnosis was also uncertain on clinical examination. Differences between studies make interpretation of the added value of expert medical photography over practice-based photography difficult. However, the observation of poor-quality images in 15% of cases in a study yielding only 48% diagnostic concordance suggests that image quality is important.<sup>10</sup> The addition of dermatoscopic photography is also facilitated by expert photographers. Our results support those of May *et al.*,<sup>3</sup> who also used medical photographers, and found an improved ability to prioritize referrals through their model, which included hospital-based photo-triage.

Although diagnostic accuracy needs to be high, a correct diagnosis is not essential for safe triage; it is more important that an expert exercises an appropriate index of suspicion over the likely nature of a lesion and chooses a suitable management route. In the study by May *et al.*,<sup>3</sup> 85%, 90% and 100% of MM, BCC and SCC cases, respectively, were correctly diagnosed. Of particular note is that those lesions not recognized on triage were all directed either to surgery or to the consultant assessment clinic, and not to a clinic for reassurance. Similarly, in a random sample of 403 patients triaged by Morino-Ramirez *et al.*,<sup>4</sup> 146 of 147 lesions that were triaged as benign were confirmed as benign on subsequent face-to-face consultation, suggesting that there is a low risk of missing cancer with SFTD where highly trained dermatologists triage the images. A recent study on the accuracy of teledermatology for pigmented lesions in 542 patients found that rates of appropriate management were at least equivalent to clinic dermatology, despite the inferiority of diagnostic accuracy compared with clinic assessment.<sup>13</sup> However, caution is advised, as the rate of appropriate management for malignant lesions was inferior, with 7 of 36 melanomas potentially mismanaged.

The filtering potential of SFTD will depend on image quality and associated referral information, the expertise of the referring doctors, and the support system to permit patients and their doctors to be advised about benign lesions and how to request review if lesions subsequently change. Several studies report high levels of filtering of referrals on the basis of practice-based photography. Moreno-Ramirez *et al.*<sup>4</sup> were able to refer 51% of lesions back to their primary care centres. Knol *et al.*<sup>14</sup> similarly reported that electronic referrals, accompanied by pictures taken by GPs, with e-mail



responses by the receiving dermatologist, could also achieve a 51% reduction in referrals.

Eminovic *et al.*<sup>15</sup> recently reported a multicentre cluster randomized controlled trial of SFTD for all skin referrals (rashes and lesions) from 85 GPs in 2 regions of the Netherlands; a panel of 5 dermatologists considered a referral preventable after advice offered by photo-triage for 39% of patients but only 18.3% of control patients. The most common diagnosis was a benign skin lesion, with 16% of these consultations considered preventable.

The models we and May *et al.*<sup>3</sup> describe involve all patients still attending the specialist service. We propose to evaluate extension of our model to offer feedback to GPs on the diagnoses of the referred lesions and direct reassurance to patients with benign lesions. It is possible that as referring GPs become more experienced, the proportion of lesions with no features of concern may reduce, hence our initial modelling of costs does not make assumptions on filtering of referrals. We suggest that evolution of a triage service is important, as we strive to minimize unnecessary clinic visits and inappropriate photography appointments. Review of experience after 6 months has led to us recommending that lesions deemed difficult to delineate by the naked eye are not routinely sent for photo-triage, as the reduced reliability of telediagnosis over face-to-face consultation is recognized for nonmelanocytic 'pink' lesions.<sup>16</sup> We now also exclude triage of lesions in children, for which we prefer to retain face-to-face discussion.

Beyond circumstances of geographical remoteness or its use in assisting expert opinion while minimizing patient journeys, teledermatology has remained limited in its routine use within the UK. An NHS R & D Technology Assessment concluded that the additional step of photographing all referred patients would have saved only 20% of patients from attending an outpatient appointment, although a surprisingly high proportion (33%) of patients in this cohort had a cutaneous malignancy.<sup>17</sup> The authors concluded with doubts over the viability of such a system dramatically reducing the need for conventional clinical consultations while maintaining patient safety.

A report capturing the views of various stakeholders in teledermatology developments across the UK NHS has recognized the value of SFTD for triage.<sup>18</sup> However, many factors are required to see the successful integration of teledermatology into practice, including demonstration that the benefits outweigh the efforts involved, with pragmatic approaches to efficacy and safety and reconceptualization of professional roles. It is generally

viewed that the vision of teledermatology as an easy technological fix for long waiting times and consultant shortages has failed to be realized, but there is increased recognition of its value as a triage and management service.<sup>19</sup>

A controlled study of 200 patients with 491 lesions has recently reported high concordance between face-to-face and teledermatological diagnosis, with only 12% of lesions having a disparate diagnosis of clinical significance.<sup>20</sup> Moreover, histological examination of suspected malignant lesions found the dermatoscopic images to be more accurate. An accompanying editorial observed the accumulation of evidence for the supportive role of teledermatology in enabling timely and appropriate treatment of patients with pigmented lesions, with technological advances facilitating capture of high-quality dermatoscopic and clinical digital images, although cost-effectiveness was not discussed.<sup>21</sup>

## Conclusion

We have confirmed that a community-based system for generating high-quality clinical and dermatoscopic images of suspected skin cancer lesions can speed access to care, and improve the efficiency and capacity of a skin cancer service in a cost-effective manner that uses the expertise of the specialist dermatological team.

We envisage additional benefits as we progress to evaluate limited filtering of patients with obvious benign diagnoses. A skin cancer triage service requires full integration within a local dermatological service, to ensure that teledermatologists should always feel able to invite patients to attend for face-to-face assessment whenever necessary, and to permit appropriate governance of the service. The place of teledermatology in routine practice continues to evolve. However, it is at present best considered an aid rather than an alternative to delivery of an efficient clinical skin cancer service.

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## Appendix 1

### Detailed costing.

Service and associated costs	Time, minutes	Unit cost, GBP	Cost, GBP
Cost of photo-triage (C <sub>p</sub> )*			
Setting up appointment (Admin band 4)	11	0.16	1.76
Photography service*	1	2.90	2.90
Photo upload (Admin band 6)	5	0.29	1.45
Photo-triage by consultant	1	1.09	1.09
Appointment allocation	5	0.16	0.80
Total cost			8.00
Consultant clinic			
Patient notes to clinic	1	5.00	5.00
Clinic time consultant	10	1.09	10.90
Clinic letter (consultant)	2	1.09	2.18
Clinic letter (secretary)	5	0.16	0.80
Total cost			18.88
Nurse clinic			
Patient notes to clinic	1	5.00	5.00
Clinic time nurse	10	0.30	2.00
Clinic letter (nurse)	2	0.30	0.60
Clinic letter (secretary)	5	0.16	0.80
Total cost			8.40

\*The photography service was delivered under a service level agreement that included equipment costs.